14.

ON

THE TREATMENT

OF

STRICTURES OF THE URETHRA

BY MECHANICAL DILATATION,

AND

OTHER DISEASES ATTENDANT ON THEM:

WITH

SOME ANATOMICAL OBSERVATIONS ON THE NATURAL FORM AND DIMENSIONS OF THE URETHRA, WITH A VIEW TO A MORE PRECISE ADAPTATION AND USE OF THE INSTRUMENTS EMPLOYED IN THEIR RELIEF.

"Si descendere placuerit [homines] et ad particularia accedere, resque ipsas attentius ac diligentius inspicere, magis vera et utilior fuerit comprehensio."

BACON, *De Aug. Scient.*, lib. iv. cap. 2.

BY

JAMES BRIGGS,

SENIOR SURGEON TO THE LOCK HOSPITAL, CONSULTING SURGEON TO THE PUBLIC DISPENSARY.

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CONTENTS.

ON

STRICTURES OF THE URETHRA.

I HAVE been induced to offer the following outlines of a mode of treating Strictures of the Urethra, from a belief, which the experience of many years has confirmed, that it possesses various advantages over the methods of treatment hitherto employed in that disease. The use of caustic applications for the cure of strictures of the urethra has of late years fallen greatly into disuse; notwithstanding the distinguished names by which this practice was formerly upheld, it seems to be fast declining in public opinion, and giving place to simpler and less hazardous modes of treatment. If we were only to judge from the accounts of those who have been the most zealous advocates of this practice, it must be allowed that their statements are not of the most encouraging description; and that the process itself is sometimes exceedingly slow and painful, and in some instances fraught with very serious evils. I think also that it may admit of doubt, both on the ground of reason and experience, whether the cure performed by the use of

caustic applications is more permanent than that effected by other means, provided the latter are such as to produce a complete dilatation of the contracted part of the canal ; so that, on the whole, I am inclined to think that the condemnation pronounced upon this practice by Mr. Sharp * has been in no degree removed by the later modifications it has undergone.

The permanency of the cure effected by caustic has been grounded on an opinion very generally received of an inherent *muscular* property of the internal membrane of the urethra, and consequently the existence of purely *spasmodic* strictures. The hypothetical notion here involved, though sanctioned by the name of Mr. Hunter, is not only irreconcileable with the anatomy of the part, as he himself admits, but appears to rest on proofs of a very ambiguous kind. Mr. Hunter seems to have been led to draw his inference in regard to the muscularity of the urethra, and to make a distinction between the *permanent* and the *spasmodic* stricture where the obstruction is produced by the spasmodic action of the urethra alone, without any alteration of structure, from the circumstance "of instruments being sometimes grasped by the strictured part when allowed to remain in the urethra for

* "In all times there have been enterprising men who have endeavoured, by escharotic applications at the extremity of their bougies, to make way through those obstacles which resist the bougie or the leaden probe ; and to say the truth, this practice has been avowed by the ablest surgeons of the last two centuries ; but at present it is universally condemned, and indeed has been so almost ever since Saviard's time."—*Critical Enquiry*, p. 152.

a time, and of a stricture sometimes allowing and at others resisting the passage of a bougie*."

The circumstance of particular parts of the canal of the urethra being more especially liable to this disease, leads to the conclusion that the cause must be connected with some peculiarity of these parts themselves not common to the whole canal. Now independently of other causes, as will be hereafter shown, the points at which the resistance to the passage of instruments is most frequently found are those where the urethra is surrounded by strong muscles exterior to the canal itself, which being excited into action, occasion the spasmodic pain and resistance which are felt in the introduction of an instrument even in the natural and healthy state of the canal. The same thing happens when a large instrument is allowed to remain for some time in the passage, and becomes so grasped as not to allow of its removal without difficulty. The resistance to the introduction of instruments in cases of stricture of the urethra, independently of other circumstances, appears to me to arise from the conjoint or separate action of two causes: 1. The spasmodic action of the muscular parts exterior to the canal; 2. The dense elastic texture of the part constituting the stricture itself, by which the instrument is mechanically opposed, becoming wedged within it.

This doctrine of the muscular property of the urethra

* On the Venereal Disease, p. 25.

would be of little consequence were it not that in its practical applications it has been since carried much farther by others, who have not only attributed to the urethra a contractile property in its healthy state, but to the altered portion of the urethra forming the stricture itself (which is sometimes converted into a substance approaching cartilage in appearance), and grounding upon it a specious argument in favour of the superior efficacy of the mode of treatment by caustic.

I cannot omit noticing here another opinion of the distinguished writer quoted, in relation to the causes of stricture in the urethra, to the effect, that the alteration in structure which diminishes the canal is seldom if ever the effect of the inflammatory action attendant on gonorrhœa, or what he terms venereal inflammation.* Neither the inflammation of the canal from this source, nor the use of stimulating injections in the treatment of it, are assuredly the exclusive causes of stricture. Were this the case, the frequency of stricture of the urethra ought to bear a much greater proportion to the multitude of examples of gonorrhœal disease than it does in fact. The production of stricture probably owes its origin to the conjoint agency of several causes; but that the inflammation accompanying gonorrhœa is a very frequent exciting cause, I think there can be little doubt. For in many instances no symptom of stricture has existed prior to the go-

* Hunter, Venereal Disease, p. 114.

norrhœal affection, or the patient at least has had no recollection of any; and the gleety discharge, which often accompanies the diminished size of the canal, is evidently to be traced to this source. An inflammatory state of the contracted part of the urethra, from whatever cause it may arise, appears to me to originate and constitute more or less the obstruction to the passage of the urine in most cases, and as that accompanying gonorrhœa is the most common to this part, it is not in accordance with facts to exclude it as a remote cause of stricture of the urethra.

I propose, in the following pages, to show that by the application of simple mechanical means, hereafter to be described, the object of restoring the urethra to its natural calibre may be effectually attained in a much shorter space of time, with far less suffering to the patient, than by the methods usually resorted to, and with the advantage also of affording more immediate relief than is generally obtained. I shall also endeavour to point out the utility of the same means for the relief of some other diseased states of the urinary organs connected with this disorder.

The remarks which are thrown together on strictures of the urethra, and other diseases consequent on them, are to be considered only as incidental to the subject, and applicable to some particular facts or points of practice to which my attention has been more particularly directed, or upon which experience has led me to adopt views somewhat different from those

which are generally entertained. Before I proceed to a detail of the proposed plan, I deem it requisite to offer a statement of some material facts connected with the anatomy of the parts, with reference especially to the use and introduction of the instruments necessary for the relief of many diseases incident to them.

It must be obvious that the first step towards the successful performance of operations, whether on the urethra or bladder, must be based on an accurate anatomical knowledge of the length, capacity, and form of the several portions of the canal of the urethra, and its general relation to the parts surrounding and more immediately connected with it. And although from the varieties met with in the several parts of the human body no single measurement of them can serve as a precise rule for the whole, yet it cannot be doubted that the more nearly an approach is made to this precision, the more secure must be the steps of operations, and the more determinate and exact the adaptation of instruments to their performance; more especially where the parts are not only concealed from view, but are at such a depth and distance from the hand of the operator that he needs every additional aid which can serve to guide him in his manipulations. I would offer as a proof of the utility of this kind of *mensurable* anatomy, if I may be allowed so to call it, the advantage that might be gained by it in the operations of sounding and cutting for the stone in the bladder, by determining the precise extent to which

the extremity of the staff or sound has actually penetrated into the bladder; in other words, the *exact length of the instrument contained within it.* For in the one case the extent of the incision into the bladder must in some degree be determined, and painful or unavailing efforts sometimes avoided in the other. Yet this point may be easily determined by previously measuring the length of the urethra by means of a graduated catheter, a method which, as far as I know, has not yet been resorted to in this country.

SECTION I.

Of the Length, Dimensions, Curvature, &c. of the Urethra..

I. The extent of the male urethra, and the length and dimensions of the several portions of the canal, from the orifice in the glans penis to its termination or entrance into the bladder, have been very variously represented by anatomists or surgeons who have directed their inquiries to this subject, with a view to its applications to practical purposes.

From the description of the instruments used in the time of Celsus,* it is reasonable to conclude that the

* "Æneæ fistulæ fiunt, quæ et omni corpore, ampliori minorique, sufficiant, ad mares, tres habendæ sunt. Ex virilibus maxima decem et quinque est digitorum, media duodecim, minima novem."—Lib. vii. cap. 3. sect. 7.

The Roman *digitus* being nearly one-fifth less than the English inch, would reduce this measure of the ancient instrument to about twelve inches.

ancient notion of the extent of the urethra (for we have no other means of judging) did not differ very materially from that which has been generally received in modern times. M. Portal * estimates the length of the urethra in the adult at 10 or 12 inches, Senac assigns to it 12 or 13, † Sir E. Home 9 inches. ‡

The greater part of the systematic writers, whether surgeons or anatomists, pass over this matter as a point altogether indefinite and indeterminate, and the few who have noticed it appear to have formed their conclusions on measurements made on the dead subject alone, which, from the flaccidity and the greater or less stretching of the parts, or from the force necessarily employed in injecting substances into the canal, must necessarily render them liable to great inaccuracy.

A more certain means of determining this point, is by drawing off the urine by means of a catheter introduced into the bladder without a stilette, upon the stem of which is marked a graduated scale of inches and fractional parts, measured from the eye of the instrument. As soon as the urine begins to flow from the catheter, which has but one opening at the extremity, the line marked on the stem corresponding with the external meatus of the urethra will necessarily in-

* Anatomie Médicale.

† "Presque cylindrique, la longueur est de douze ou treize pouces, la grosseur approche une plume à écrire."

‡ Observations on Strictures of the Urethra, vol. i. p. 24. He adds, however, in a note, that "in common the canal is about $8\frac{1}{2}$ inches long."

dicate the exact length of the canal, or the distance from the meatus to its termination in the bladder.

Of sixty persons in whom the urethra was measured in this manner, the length was found to vary from $6\frac{3}{4}$ to $8\frac{1}{2}$ inches. In eight instances, or rather less than one-seventh of the whole (twenty of them being persons of short stature, or not exceeding 5 feet 4 inches in height), the length of the urethra was found to be under 7 inches. In forty-five instances, or three-fourths of the number, *i. e.* in persons of middle stature, the measurement was found to be between 7 and 8 inches, and in a few it exceeded 8. In some instances of very corpulent subjects at an advanced age, the urethra was found to be ten inches in length, the increased length of the canal probably arising in these cases from the greater flaccidity of the parts, and superabundant quantity of adipose membrane surrounding them.

It being reasonable to infer that the several parts of the human body have a general though not an absolute or definite relative proportion to each other, it follows that in individuals of the same stature the length of the canal of the urethra ought, *cæteris paribus*, to be equal; and this is found to accord sufficiently with the admeasurement made by means of the catheter, for all practical purposes. As the canal of the urethra ranges in length from $6\frac{3}{4}$ to $8\frac{1}{2}$ inches, the medium or average length of the passage may be taken to be $7\frac{1}{2}$ or $7\frac{3}{4}$ inches.

In determining this point, it is necessary to observe that the external parts are supposed to be in a natural condition, neither hanging in a loose flabby state, as is sometimes the case, nor unusually retracted towards the pubes.

On several occasions I have taken casts of the urethra after death, with plaster of Paris, and the measurements of the parts thus obtained have been found to coincide with those made on the living subject by the means above mentioned.

Under some peculiar circumstances of extreme distension of the bladder it does seem unquestionable that the urethra undergoes a change in its length by the ascent of the bladder, and the consequent stretching and elongation of the portion terminating in the neck of the bladder, of which M. Deschamps has furnished a remarkable example *, and that it is also

* " En 1792 je fus appellé pour sonder M. Lagarde, vieillard octogénaire, habituellement attaqué d'une rétention d'urine, suite de paralysie de la vessie, et pour laquelle M. Louis l'avoit déjà sondé nombre de fois ; instruit que cet habile chirurgien avoit été obligé pour réussir à pénétrer dans la vessie de faire construire une algalie de près de quatorze pouces de longueur, je me servis d'une des plus longues que j'avois, et qui avoit près de treize pouces ; elle se trouva trop courte, et je fus obligé d'avoir recours à celle de M. Louis, qui entrée dans la vessie, ne se trouva que de longueur juste ; dans une consultation où nous nous trouvâmes ensemble chez le malade, il fut décidé d'en faire construire une de gomme élastique de la même longueur. Nous nous en servîmes chaque fois que la sonde s'échappoit de la vessie, ce qui arrivoit assez souvent par l'indocilité du malade. Dans l'intervalle d'une rétention à l'autre, une sonde de longueur ordinaire suffisoit, la vessie vide ne tirant plus le col vers l'ombilic.

" Plusieurs fois nous avons été obligés dans des cas semblables,

influenced by enlargements of the prostate gland ; but having on several occasions had an opportunity of determining this point by examination of the bladder of the same subject in its distended and contracted state, I feel warranted in concluding that under ordinary circumstances the distance from the orifice in the glans to the internal aperture in the bladder undergoes no material alteration *.

The length of the several parts of the urethra has been variously computed. According to Sir E. Home, the length of the prostatic portion, or that lying within the prostate gland, is $\frac{1}{2}$ an inch ; membranous part, extending from the bulb to the prostate, $1\frac{1}{2}$ inch ; remaining part to the external orifice, 7 inches = 9 in.

Camper as well as Portal, on the other hand, estimate the relative length of the membranous part and prostate gland thus :—Prostatic portion, $1\frac{1}{2}$ inch ; membranous, 1 inch ; Hey, membranous part, 1 inch ; Lieutaud †, as cited by Camper, 8 lines or $\frac{3}{4}$ of an inch ; Bichât ‡, membranous part about a finger's breadth in extent.

In the plaster cast of a vertical section of the male pelvis I found the following to be the proportions of

M. Boyer, mon aide à l'Hôpital de la Charité, et moi, d'avoir recours à cette grande sonde pour pénétrer dans la vessie."—*Traité de l'Opération de la Taille*, tom. i. p. 221.

* In a case of contracted bladder I found the variation in the length of the urethra to be somewhat less in proportion to the distension of the bladder by the injection of warm water.

† " Quâ sphincterem excipit."—*Mém. de l'Acad. de Science*, 1753.

‡ Anat. Descript. tom. 5.

the several parts of the urethra:—from the orifice to the membranous part, $6\frac{1}{2}$ inches; from thence to the bladder, $1\frac{3}{4}$ inch $= 8\frac{1}{4}$.

It is scarcely necessary to observe that the extent of these several portions of the urethra must of necessity vary in different individuals, as the length of the canal itself varies; and that no precise limit can be assigned to them such as might be inferred from the authorities here adduced.

II. Anatomists, down to the time of M. Senac (*i. e.* the middle of the last century), and even Bichât* at a much later period, describe the canal of the urethra as cylindrical, or nearly so, and take no notice of certain inequalities which seem to belong to adult age. When the urethra in the adult is laid open through its whole extent, from the meatus externus to its termination in the bladder, the canal exhibits a difference in its form, width, and texture, according to the structure of the parts through which it passes. In its course through the glans penis it is flattened, its two sides being in contact; within the prostate gland it is nearly flat, except at the lower part, where its sides are kept asunder by the verumontanum, which projects upwards leaving a sulcus on each side of it. In its passage through the glans it admits of less dilatation than elsewhere, owing to the dense structure and higher sensibility of the part. From the glans penis,

* "The spongy layer from the bulb as far as the glans forms a true cylindrical canal."—*Anat. Descript.* tom. v. p. 223.

after expanding a little, the urethra gradually increases in width as far as the attachment of the ligamentum suspensorium (*i. e.* at the distance of about 3 or $3\frac{1}{2}$ inches from the meatus), it then decreases as it approaches the symphysis pubis; the portion extending from thence to the prostate gland, especially the membranous portion, being found to be in appearance the narrowest part of the canal. The dimensions of some of these parts are materially altered when the urethra is distended by injecting it with wax, or other similar substances *.

M. Le Cat †, in the middle of the last century, made casts of the urethra by filling it with wax, and afterwards glue, for the purpose of determining the capacity and form of the canal. He found by this means the two broadest parts of it to be the prostatic, and that within the bulb, portions to which he respectively applied the term of *gulphs*; and he notices its marrow and oblique opening at the point of its entrance into the bladder.

Sir E. Home ‡, though probably unaware of what had been already done by M. Le Cat, or at least without referring to him, proceeded with the same views in a similar manner, and has given plates of the

* According to Bichât, "The membranous portion is the thinnest and narrowest part of the canal; at the bulb it takes a much greater size, which is continued to the base of the glans."—*Anat. Descript.* tom. v. p. 118, 119.

† Philos. Trans. vol. xli.

‡ Observations on Strictures of the Urethra, vol. i. p. 28.

casts made by him representing the figure and dimensions, as well as what he considers to be the natural curve of the urethra, thus determined. From the figure of the urethra thus obtained, he has endeavoured to demonstrate the cause of the frequent occurrence of stricture at the point of the canal where the bulb and membranous portion meet, which he found to become suddenly narrower and more constricted than the rest. According to Bell, there is a neat band or ligament surrounding it at this part. A similar appearance is also described by Bichât, who says: "The pars spongiosa terminates in a remarkable enlargement called the bulb, behind which the urethra appears as if it were *strangled*;" and most anatomists seem to regard this as a true representation of this part of the canal of the urethra.

Notwithstanding the weight of these authorities, after employing various substances for the purpose of obtaining casts of the urethra, with a view to determine the form and curvature of the passage, I have been at a loss to reconcile the appearances which they afford with the descriptions made by Sir E. Home and others, from which in most respects they widely differ. Neither in these casts of the urethra, nor in the figure of that of M. Le Cat, is there any sudden narrowing or constriction of the membranous part of the canal at the point alluded to, nor resemblance in the shape of the curve, such as is represented in these plates.

The portion of the urethra which extends from the

apex of the prostate gland forward to a short distance beyond the arch of the symphysis of the ossa pubis, and in the natural state is the narrowest part of it, when distended, greatly exceeds the rest of the canal in its dimensions, and forms a large oblong sinus measuring from $1\frac{1}{4}$ to $1\frac{3}{4}$ inch in length, and in its transverse diameter at the broadest part from $\frac{10}{20}$ths to $\frac{12}{20}$ths of an inch, the part of the urethra anterior to it not exceeding $\frac{7}{20}$ths of an inch. The broadest part of this sinus lies directly under the cartilaginous arch of the symphysis pubis and above the bulb of the urethra, the latter of which with Cowper's glands lies over and conceals the membranous portion. The bulb is continuous, or nearly so, with the prostate gland, and is covered by a dense fascia, which extends to the erectores penis muscles, there being little or no space or interval between them, such as is usually artificially represented in dissections of those parts when the bulb is detached from the membranous portion and made to appear pendulous. The narrow part of the canal, as seen in these injections of the urethra, is at the point of union between the membranous and prostatic portions, *i. e.* immediately before its entrance into the prostate gland, where the two are united by a very small neck.

The irregularities in the form of the urethra here noticed do not appear to exist at the earlier periods of life. In a cast of the urethra obtained from a boy eleven years of age, made by injecting wax, no in-

equalities such as those above mentioned in the adult were observable throughout its course, the diameter of the cast, which is nearly cylindrical, measuring pretty uniformly $\frac{1}{5}$th of an inch.

From these facts I think it may be reasonably concluded, that the calibre of the urethra before puberty, or in the original formation of the part, is nearly uniform in its figure and dimensions; and that the great change which takes place in the capacity of the membranous portion of the urethra in adult age, as demonstrated by injections, is simultaneous with the development of the other parts closely connected with it and subservient to generation, *i. e.* the prostate gland, vesiculæ seminales*, and Cowper's glands, to the secretions of which it may be supposed to serve the office of a receptacle, until acted on by the strong muscular parts which surround it, and by their action restored to its ordinary dimensions; and that the peculiar appearances described by Sir E. Home must have arisen from some accidental circumstances occasioning a deviation from the natural and ordinary state of those parts, and consequently are insufficient to supply grounds for a satisfactory explanation of the frequency of stricture at the particular part of the canal alluded to.

III. The curve which the urethra makes before its

* "In a child three years of age, I found the vesiculæ seminales so imperfectly formed, that it was impossible to inflate them with the blow-pipe; and Biehât affirms that they are very imperfectly developed even at the age of 14 or 15."—Tom. v. p. 244.

termination in the bladder comprises a larger portion of the canal than is usually assigned to it. Bichât * seems to include in the *curve*, the bulb and membranous part only ; and I believe this to be the sense in which the term is usually taken ; but, strictly speaking, it comprises, besides these parts, the prostate gland and a portion of the canal anterior to the bulb, commencing at about an inch anterior to the cartilaginous arch of the ossa pubis, or the point where the corpus spongiosum becomes fixed, corresponding with the boundary marked by the anterior fibres of the acceleratores urinæ muscles, the prostatic portion being rather more curved than the rest.

In a plaster cast taken from a lateral vertical section of the pelvis of an adult (after the urethra had been injected with wax), the curve was found to commence at $1\frac{1}{2}$ inch anterior to the bulb, and from this point to its termination in the bladder to form an arc of a circle of $3\frac{1}{4}$ inches in diameter, the chord of the arc being $2\frac{3}{4}$ inches, or rather less than one-third of the circumference. In another cast the chord of the segment was found to measure $2\frac{8}{10}$ths inches of a circle of $3\frac{1}{8}$ inches in diameter ; the inclination of the internal orifice, or entrance of this part into the bladder, forming an obtuse angle with the general course of the urethra.

In young subjects the ascending posterior portion rises nearly at right angles from the rest of the canal,

* Anat. Descript., tom. v. p. 218.

and consequently makes a much sharper bend; this ascending portion is also comparatively longer than in the adult, a fact which is corroborated by the accurate observations of Camper*, who states that in infants the fundus of the bladder is situated higher in the pelvis than in adults, and gradually descends, and that in them the curvature of the urethra is consequently greater. Bichât affirms that the directions of the urethra before puberty, from its origin to the symphysis, is more oblique than in the adult, in consequence of the lengthened form of the bladder, which is greatly elevated towards the abdomen, and follows the inclination of the upper aperture of the pelvis†.

These facts sufficiently demonstrate that the curvature of the urethra gradually diminishes with age to the time of puberty; a matter indeed which is conformable to common experience from the necessity of altering the form of the catheter so as to suit it to individual cases, and the extreme curve required to be given to it, in order to adapt it to the earlier periods of life.

Although the degree of curvature of the urethra in adult age varies in different individuals, yet it does so within determinate and narrower limits than I think are commonly supposed. I am led to infer that this variation, like the length and capacity of the canal,

* "In recenter natis vesica basi suâ elatius sita, pedetentim descendit, unde necessario sequitur curvaturam urethræ majorem esse in junioribus quam in adultis."—*Demonst. Anat. Pathol.*, lib. ii. p. 13.

† Anat. Descript., tom. v. p. 241.

bears a relation to the general bodily stature, having found generally, by the manner in which instruments enter the bladder, that in persons of short stature the sweep which the instrument makes is more sudden, and the handle carried lower than in those of large make, in whom it is oftener requisite to press the catheter backwards in a horizontal direction. M. Deschamps *, in speaking of the adaptation of instruments of different curves to the figure of the canal, observes, " C'est une erreur de croire qu'il faut différentes courbures suivant les différens cas : *l'urètre chez tous les sujets en a une déterminée et qui varie très peu chez eux* ; ce n'est que dans le cas d'une grande extension de la vessie, que le col plus allongé donne une direction plus droite à la partie du canal qui se trouve sous la voute du *pubis* ; c'est alors qu'il est indispensable d'avoir recours à une courbure legère laquelle convient dans tous les cas."

The most depending part of the curve is at the point where the membranous portion would be intersected by a line drawn through the longitudinal axis of the symphysis pubis to the anus, which would divide it into two very equal parts, and pass through the centre of the most dilated part of the urethra or sinus before mentioned, a part of the canal which is naturally the narrowest, but, as seen in the casts alluded to, is from its structure the most yielding and capacious part of the urethra.

* Traité de l'Opération de la Taille, t. i. p. 211.

IV. The muscles chiefly concerned in the actions of the urethra are the levator ani and acceleratores urinæ. The former closely encompasses the prostate gland and membranous portion of the urethra. The accelerator urinæ is continued forward, covering the urethra as far as the point where the penis beomes loose and pendulous, and forms in that state an elbow or angle; the terminating portion of these muscles anteriorly corresponds very nearly with those parts of the canal at which strictures of the urethra are most commonly found to commence, *i. e.* at the distance of $5\frac{1}{2}$ and $3\frac{1}{2}$ inches from the external orifice, but more especially at the former, or where the levator ani terminates; and it is from the narrower dimensions of the canal at this part, and the contraction of the levator ani compressing the portion beyond it, that a resistance to the introduction of instruments, even where the parts are in their natural healthy state, is here so commonly experienced.

It is partly to the reaction of these muscles exterior to the canal of the urethra that instruments, when suffered to remain long in the passage, become grasped, the spasmodic action being especially perceptible while the instrument is being withdrawn; and it is this circumstance, I apprehend, added to an irritable state of the canal, that has given rise to a notion of the existence of spasmodic strictures, and the more hypothetical one of the muscular property of the mucous membrane of the urethra itself.

But besides the action of these muscles, the membranous lining of the urethra possesses an inherent property, and that in a remarkable degree at an early period of life, a fact which seems to me to have been hitherto unnoticed, viz. its elastic property. In examining the body of a child three years old, I found the aperture of the urethra so small as scarcely to admit the point of a knitting-needle, yet it readily admitted a common blowpipe to pass through it, and as speedily recovered its former state. On slitting it up, the internal surface was disposed in longitudinal folds, resembling in this respect the collapsed urethra in some classes of quadrupeds *.

An appearance similar to this is described by Bichât † in the mucous lining of the urethra of the adult, except within the prostate or glans, where the texture is denser, which he refers to the habitual contraction of the canal when not dilated by the urine, or during erection. It is to this property that we must refer, I think, the obvious facts of the force with which the column of urine is propelled from the bladder, and a certain springiness or resistance of the parts which is felt on the introduction of instruments at this period of life.

* In the wether and ox the mucous membrane of the urethra is highly elastic, and in the collapsed state, when slit open, is disposed in minute longitudinal lines or ridges, having small sulci between them; in the ox the corpora cavernosa are enveloped in a thick, elastic ligamentous sheath.

† Anat. Descript., t. v. p. 220.

From these and other facts I have been led to entertain an opinion that the ready expansibility and contractility of the internal membrane of the urethra, which have been ascribed to its muscularity, are in fact the results of this *elastic property*.

The several circumstances here mentioned explain satisfactorily why, in the introduction of the catheter or sound, the instrument is usually stopped in certain parts of its course, and why, from any causes inducing inflammation in the canal, such parts are more liable to become the seat of stricture.

SECTION II.

Of the Introduction of Instruments into the Bladder.

When it is considered that the urethra in its natural state is incapable, from its yielding texture and comparatively loose attachments, of resisting a certain degree of force, and admits of being greatly altered from its natural form, and that instruments of various degrees of curvature, from the straight catheter of Paulus Ægineta* and Albucasis, to the double-hooked instrument of Petit, have been in use at different times, it may seem to warrant the conclusion that the choice of the form of the instrument employed in most cases is a matter of little importance.

But I believe it must be admitted, that the nearer

* lib. 6. cap. 59.

the instrument approaches in its shape to the natural form of the urethra, the more easy and certain will be its passage and introduction into the bladder. The necessity of this correspondence becomes of far greater importance where other besides the natural difficulties are to be encountered in its introduction.

It is the result of general experience, I think, that the catheter or sound made with a short bend enters the bladder more easily, and is more commodiously employed than when constructed with a longer and more expanded arch, and this shape is in fact found to coincide in a very great degree with the curve of the urethra before described. I believe, however, that it will be found advantageous that the curve of the instrument should be in all cases rather less than that of the urethra itself, otherwise the weight of the instrument acting as a lever would in its passage through the posterior portion of the canal cause the point to have a constant tendency to describe an arc of a circle less than that of the instrument itself, and consequently to press constantly against the upper surface of the canal, and when in the bladder to come in contact, or nearly so, with the anterior part of that viscus. This remark must be understood to apply to the form of the instrument in the simple introduction of it into the bladder, and not with reference to any ulterior purpose, such as lithotomy, in which the position of the instrument, after its introduction into the bladder

in relation to the parts around it, may be the paramount consideration *.

The modes of introducing instruments into the bladder have been so frequently described, that it may perhaps be deemed superfluous or presumptuous to add anything to the rules already laid down for the procedure in such cases. Yet as I consider that the success of the means hereafter to be described is greatly dependent on the manner in which instruments are employed, and notwithstanding all that has been written, that the operation of passing the catheter is not unfrequently attempted in a way not the most likely to ensure its success, I have been led to make some remarks upon it, and to describe what appears to me essential to its successful performance.

In some instances the introduction of an instrument into the bladder is so easy, that it is a matter of indifference in what position the patient is placed, or in what manner the instrument is held.

Mr. Sharpe, Sabatier, Mr. Hey, Chopart †, and the greater number of writers, follow the method of Celsus in recommending that the patient be placed in a re-

* The curve of such an instrument would approach the arc, or one-third of a circle of 4 inches diameter. The figure of Mr. Sharpe's instrument, drawn by Camper, to which he gives a preference, has a larger bend, or more strictly speaking, forms an arc of a larger circle; but it must be observed that this shape is not in reference to its easy introduction, but its position within the cavity of the bladder in the operation of lithotomy.

† Tom. ii. p. 226.

cumbent position, a method which, however, is both disadvantageous and inconvenient. For myself, I greatly prefer the erect position when the patient is able to rise, as not only that which is most commodious to the operator, but that in which he is most certain of the exact situation of the point of his instrument, and can exercise the nicest tact. The weight of the instrument alone, indeed, and its property to act as a lever, when the patient is erect, fit it best to overcome the resistance which is made by the reaction of the muscular parts surrounding the fixed portion of the urethra nearest the bladder. The operator is also more certain of success when the instrument is introduced with the concave part turned downwards, by which means its point will be in the line of the descending portion of the curve, and being pressed forward as far as it will go, will be made to advance to the most depending part of the curve of the urethra, this part being the narrowest and most yielding part of the canal, a point not easily determined when the instrument is passed in the contrary direction. In changing the position of the instrument by turning the concave part towards the abdomen (or making what the French term the *tour de maitre*), care must be taken that the point does not recede from the part of the canal which it had reached.

Supposing, therefore, the instrument, after having been steadily pressed forward in its first position, until it is found to advance no further, to have been

turned, and the handle drawn a little towards the operator, so that it shall form an obtuse angle with the abdomen, the weight of the handle alone acting as the long arm of a lever will be often sufficient to carry it into the bladder without any guidance or additional pressure by the hand, or if it should not, the slightest imaginable degree of pressure in aid of its weight will be adequate to complete its introduction.

But the point most essential to the success of the procedure, which is not to be defined by words, and can only be acquired by experience, is the nice perception, or tact as it is called, of the resistance and the degree of pressure necessary to overcome it by the hand of the operator. All force used in the introduction of instruments through the urethra into the bladder ought to be avoided, not only as it is unnecessary, but as it is the surest means to frustrate the attempt; and indeed the necessity of employing force is the strongest indication of the point of the instrument not being in the true direction of the canal. Such at least has been my experience: the most cautious and gentle methods have been those by which I have been most successful, and I have had as constant reason to regret a contrary practice.

The necessity of proceeding with extreme caution, independently of any other consideration, is therefore most material to the success of the operation *. Mr.

* "Chirurgus in operando cautus, et a periculo festinatione alienissimus esse."—Haller, *Disput. Chir.*, t. iv. p. 455.

Hey * has well expressed the meaning of the word *tact* (delicacy of feel), by the expression, of "eluding rather than overcoming the obstacle," and Sir E. Home somewhere aptly compares it to that which an engraver employs in the use of his style.

The difficulties which attend the introduction of instruments into the bladder, do not arise, as Sharpe † supposed, from the rugæ of the urethra or the resistance of the verumontanum, but from certain portions of the canal being narrower than the rest, from the peculiar curve which the canal makes beneath the symphysis pubis, and from the action of certain muscles surrounding this latter part of it. If an instrument be passed along the urethra in its natural and healthy state, it is usually found to be stopped in its course at the distance of $5\frac{1}{2}$ inches from the external orifice, or thereabouts; and it is at this part only that any difficulty is experienced in the introduction of instruments into the bladder in the natural state of the parts. The resistance to the instrument is not caused merely by this portion of the urethra being narrower than the rest, nor by the change in the direction of the canal, but arises, as already stated, in part from the muscles surrounding this portion of the canal being excited to action, and closing up the passage. The fibres of the levator ani, in their course from the rectum to the ossa pubis, closely embrace the prostate gland and membra-

* Observations in Surgery, p. 393.

† Ibid, p. 34.

nous part, if not a portion of the bulb, and the anterior edge of this muscle terminates at the point corresponding with the narrow part of the urethra. During the passage of an instrument through this part of the urethra, the patient constantly experiences a spasmodic sensation, marking the reaction of the levator ani upon it; and the power which the muscle possesses may be judged of in withdrawing the instrument from that part of the passage, by the force with which it is grasped at intervals, corresponding with the alternate contraction and relaxation of the muscular fibres. These anatomical facts serve to explain, in my opinion, not only the cause of the resistance made to the passage of instruments at this part of the urethra, but also of its being the most frequent seat of stricture. It must be evident, therefore, that to overcome this cause of resistance arising from the reaction of the muscular parts to an extraneous force, the use of any violent or sudden means is most likely to excite or increase the obstacle, and it is to this circumstance I would attribute the most frequent cause of failure in the introduction of instruments into the bladder. The part of the urethra corresponding to the bulb having a greater capacity, and not being fixed in its situation like the narrow membranous portion, allows to the point of the instrument a certain latitude of motion. If therefore the point of the instrument, having reached this yielding part of the canal, is either elevated or pushed onwards before sufficient time has been allowed to

this narrow portion and the muscular parts around it to relax, this loose portion of the urethra, as may be easily foreseen, will be pushed forward and form a fold or pouch, and allow the instrument to advance so far as to induce a belief that it is actually within, or on the point of entering the bladder ; and this I take to be the true nature of the obstacle usually met with, or rather created, where the parts are in a natural state. In order to obviate this difficulty, some surgeons are in the habit of drawing forward the penis upon the catheter or other instrument ; and M. La Fage holds the necessity of maintaining a sort of concert between the hand of the operator thus engaged and the instrument, and rather drawing the part upon the instrument than pressing the instrument forward through the part. This maxim is adopted by Chopart *, and I believe the French surgeons generally ; yet it must be very obvious that the drawing forward the penis can produce little or no change on the fixed part of the urethra, or even on that near to the bulb, so that it is useless and unnecessary, unless where the obstruction is in the anterior portion of the canal. It is also calculated to mislead the surgeon with respect to the exact depth to which the instrument has penetrated.

The introduction of the finger per anum, or the pressing upon the perinæum with the fingers as a *point d'appui*, after slightly withdrawing the point,

* Traité des Maladies des Voies Urinaires, t. ii. p. 226.

are the methods which are commonly resorted to, under circumstances of difficulty, for the purpose of elevating the point of the instrument ; or where a flexible catheter is used, of drawing back the stilette, in order at the same time to alter its curve. Where a flexible instrument is employed these means may be occasionally found to succeed, but as far as regards the introduction of a solid or metallic instrument, they are wholly unnecessary, as the point of the instrument forms the point of a lever which, by the management of the handle, may be made to act at any angle that may be requisite ; and the real cause of the difficulty does not arise in general from the point of the instrument not being sufficiently raised, but from its being directed upwards before it has entered the fixed or ascending portion of the urethra, which lies immediately below the symphysis pubis.

A fortuitous success will sometimes attend attempts of this kind to discover the right passage, but repeated unsuccessful efforts serve to increase the difficulty, and lessen the prospect of success ; and where the necessity of introducing an instrument is not urgent, as in the case of searching for the stone, it is more prudent to defer any new attempt to do so until the parts have had time to recover themselves.

SECTION III.

Of the Treatment of Strictures in the Urethra.

It is a principle laid down by Mr. Hunter, that whenever a bougie, be it ever so fine, can be made to enter a stricture, the cure though slow can be effected by mechanical means,—that the recovery of the patient is now in the hands of the surgeon ; and he expressly states that it was only in cases where no passage could be found by this means that he had recourse to the use of caustic. It would appear, therefore, that his advocacy of the latter method did not arise from any supposition of its superior efficacy, but from the imperfection of the mechanical means which he employed to effect his purpose of entering the bladder.

Valuable as I consider the common wax bougie under particular circumstances in the treatment of stricture of the urethra, it is not the best adapted as a general means, in respect of its mechanical properties, to dilate the contracted part of the canal. From its yielding at the point, it frequently becomes coiled up, so as to render its removal painful, and the operator cannot easily distinguish between this effect upon the bougie and its passage forward along the canal.

Flexible instruments, of whatever materials they are composed, especially when the stricture, as is usually the case, is seated in a distant part of the canal, can-

not be made to act in the line of the urethra by the hand of the operator, and consequently in the direction most favourable to overcome resistance; for whatever advantage is gained on the one hand by the pliancy of the instrument, and its ready adaptation to irregularities in the canal, is lost in its mechanical power. The peculiar utility of flexible instruments is their applicability to those cases in which the contracted part deviates from the natural line of the canal, or when the course of the canal is unusually tortuous and irregular.

Where fine instruments are required, those made of flexible materials, such as caoutchouc or elastic gum, catgut, and flexible metal, are less adapted to follow the irregularities in the passage of the urethra than the common bougie: in consequence of their firmer texture when pressure is used, they are apt to yield in the middle, or at a part distant from that in which the canal deviates from its natural course. Instruments of this description may be useful where the obstruction is in the anterior portion of the canal, but generally they can be so in no other case.

In consequence of the adhesion of the soft surface of the bougie to the membranous lining of the urethra, and its tendency, even where it has been previously bent, to assume a straight form, and of the necessity of its being moulded in some degree to the form of the urethra by the *force* of the pressure made upon it, there must always be considerable resistance

to the passage of such an instrument, which can only be overcome by its being pressed onwards. For this reason the complete dilatation of the stricture by such means must be always tedious, as the part will not admit of the introduction of a bougie of much larger dimensions at any one time; and when the point becomes entangled, the surgeon has no means of altering its direction, which can only be effected by the resistance of that part of the canal against which it presses, and the uneasiness attending it renders a repetition of the process impracticable without an interval of some days' rest, during which the contracted part relapses nearly into its former state. To render its effect more lasting, the bougie is often suffered to remain in the urethra for an hour, or even longer, at each application. When the point of the bougie has penetrated a short way within the stricture, the waxy coating is sometimes raised by the tightness of the part, so as to destroy its wedge-shape, and thereby form a complete obstacle to its further admission.

Notwithstanding these defects in the mechanical properties of the bougie as an exclusive means of treating strictures of the urethra, its peculiar flexibility renders it, under certain circumstances, a most indispensable auxiliary to the means hereafter to be mentioned.

The instruments which I have been in the habit of using for many years are steel sounds, which together may be considered as forming a succession, or

progressive series, of cones or wedges. The conical part of the instrument is about an inch in length, extending from the bend to a short distance from its point, the rest of it being of equal thickness. It has a definite curve, and is ground on each side, so as to leave an obtuse edge or projecting line running on the concave side, from within half an inch of the point to the part where the curve terminates. The extreme point to the extent of a quarter of an inch is uniform. The point of one instrument corresponds in size with the thick part or stem of the next, or is somewhat less. The difference between any two of the instruments in thickness, or between the point and stem of each, is about $\frac{1}{48}$th of an inch, or $\frac{1}{4}$th of the French line ; the point of the smallest of these instruments measures in thickness $\frac{3}{48}$ths or $\frac{1}{16}$th of an inch, the stem $\frac{4}{48}$ths, or $\frac{1}{12}$th of an inch ; that of the largest instrument $\frac{14}{48}$ths, the stem $\frac{16}{48}$ths, or $\frac{1}{3}$rd of an inch*.

By giving an obtuse edge to a part of the cone of the instrument, which by the flattening of the two sides is nearly triangular, less resistance is made to its passage through the stricture, and a dilatation of the part is far more readily effected than by the mere conical sound ; and more especially in the denser kinds of stricture, the removal of which cannot be effected

* The series consists of ten or twelve of such instruments, but provided the principle of proportion in their construction be kept in view, the number or precise dimensions are I think immaterial.

without great perseverance in the ordinary and tedious process of treatment by the common bougie.

As a steel instrument admits of a high degree of polish, it passes with far more ease to the patient than a bougie, can be guided with more certainty to the contracted portion of the canal, and the point so directed as to act successively on any part of the canal in the line of its axis; where the constricted part, as most frequently happens, is seated at the curve of the passage, the weight of the handle alone acting as the long arm of a lever, greatly increases its mechanical power, and makes a more uniform and steady pressure on the part to be dilated than any force applied to it by the hand of the surgeon. It is also more easily withdrawn, and with less pain to the patient, where it has been grasped by the stricture and allowed to remain in the passage for some time, than the common or cylindrical sound.

Another advantage in the use of solid instruments generally is, that by observing the position and extent to which the sound has penetrated at the moment when it enters the stricture, the operator obtains a guide for his future operations which he could not have gained by the use of a yielding instrument.

By the introduction of such instruments in almost uninterrupted succession, the contracted part of the urethra may be often enlarged, almost at pleasure, to the extent of the rest of the canal, and very often at one time, especially where the stricture is confined to

a very small portion of the canal, with as little pain as the patient would experience from a single introduction of a full-sized bougie.

The instruments now described, which may be said to unite the properties of the wedge and lever, are designed especially for the enlargement of the contracted portion of the urethra, after the situation of the stricture has been accurately determined, and a passage effected either completely into the bladder, or at least through the diminished part of the canal by other means; for I hold it indispensable, that until an instrument, however fine, can be so far introduced, no attempts which require any force should be made, the consequences of which would be to endanger the formation of a false passage. It is this first step in the procedure which forms the principal difficulty in the execution of this plan of treatment, and it requires the utmost caution and delicacy in its management to ensure its success, especially where the stricture is exceedingly small, or deviates from the line of the axis of the canal.

For this purpose, having first determined the situation of the stricture (suppose as is most usual at the distance of $5\frac{1}{2}$ inches from the meatus), a bougie of the finest kind should be passed down to the part, and pressed against it steadily but with the utmost gentleness; for it should be observed, that although the resistance to the point of the bougie be formed chiefly by the altered structure and the diminished

calibre of that portion of the canal, yet that it is in part also occasioned by the contraction of the muscular parts around, which the use of force would only tend to increase. A very fine bougie, which has lain by for some time, so as to acquire a great degree of firmness, and which, as Mr. Hunter has remarked, is only tapered at a short distance from the point, so as to have greater solidity, will be found most useful.

If an attempt to introduce a very fine bougie through the stricture should be unsuccessful, or the point be found barely to have entered the contracted part, which may be judged of by the impression made on it, a steel sound of equal fineness, or $\frac{3}{48}$ths of an inch, and of uniform thickness*, is to be carefully passed down to the point of obstruction, and gentle pressure made upon it in the manner before described, *i. e.* with the convexity of the instrument upwards until the point will no longer advance in that direction; it is then to be turned upwards, with the concave part towards the abdomen, and drawn gently downwards.

During this movement of the instrument it will sometimes be found to have advanced beyond the point at which the bougie had been stopped; but if this should not be the case, the instrument should be suffered to rest there awhile, and as it will now make an oblique angle with the line of the abdomen, it will by its own weight, the handle acting as a lever, make

* Or it may be useful to have two or three plain wire sounds, varying a little in thickness and curvature.

a steady but slight pressure on the obstructing point, and with the advantage of being as nearly as possible in the line of the axis of the canal; or its own weight may be occasionally slightly assisted by the finger. By pressing the instrument gently against the stricture, and varying a little the direction of the point, or allowing it to remain in contact with it for a short time, the patient merely guarding it with his finger to prevent its falling sideways, I have frequently found it to slip onward a short distance by a sudden jerk, and sometimes two or three times successively, according to the number of the obstructions.

In cases of difficulty great advantage is gained by introducing the bougie or other instrument immediately after the patient has been directed to empty the bladder: by this means, an instrument has sometimes found its way through a very narrow stricture, when the ordinary means of attempting it have repeatedly failed.

By some one or other of these methods, although a first or second attempt should prove unsuccessful, a fine steel wire sound of $\frac{3}{48}$ or $\frac{4}{48}$ thickness, will in most cases find its way into the bladder; and I am inclined to think the instances of failure will be found exceedingly rare. But even where the point of a very fine bougie or sound has merely penetrated the aperture of the stricture, the urine will flow with less difficulty, and the instrument will be found to enter on a subsequent trial which would not pass before.

Instances do occur in which the opening in the stricture is so narrow as not to admit the point of the finest wax bougie. In two or three such cases I have succeeded in passing a whalebone bougie, the point of which has scarcely exceeded the fineness of a bristle. In order to fit the whalebone for this purpose, it is necessary to soften it in warm water, and keep it for some time in a catheter, by which it will acquire a permanent curve.

In all attempts to discover the course of the urethra, and especially where the stricture is very small, great care should be taken not to irritate the parts by too frequent attempts, nor by renewing them at too short intervals before the parts have regained their quiescent state. I believe unsuccessful efforts of this kind to be a frequent cause of failure, having been several times foiled in my endeavours to effect a passage by renewing the attempts on the third or fourth day, when to my surprise, by waiting a week, a bougie or sound has been passed without the smallest difficulty.

As soon as an instrument of this kind, or a very fine bougie, has penetrated through the stricture into the bladder, or through the stricture only, I conceive it to be in the power of the surgeon to enlarge the contracted part of the urethra, not only to any extent that may be judged proper, but almost at his own option.

Supposing therefore such an instrument to have

been introduced and withdrawn after being retained in the urethra for a short time, a fine conical sound, the point of which does not exceed the dimensions of the plain instrument or bougie, increasing in thickness $\frac{1}{48}$th to as far as the middle of the curve, is in the same manner to be immediately passed down with great caution to the part forming the stricture before it has time to collapse.

The opening in the stricture being now sufficiently large to admit the point of the instrument, it must of necessity, having penetrated within it, follow the proper course of the canal, the resistance to its passage being made by the pressure of the stricture upon the thicker portion of the cone. It is therefore evident that the action of the instrument must be confined to the contracted portion of the urethra, and that a false passage cannot be formed in this way, such an injury being necessarily made by the point of it alone at a part anterior to the stricture, and before it has penetrated the contracted portion.

As the conical sound unites in itself the power of the wedge and lever, it requires a very slight pressure of the finger to aid its own weight in propelling it onwards into the bladder. The same steps and cautious procedure must be followed in the introduction of each successive sound in the series.

The degree to which the enlargement of the stricture may be carried at any one time, must necessarily depend on the greater or less extent of the contracted

part of the canal, and the resistance made to the passage of the instrument. In the slighter cases where the stricture is confined to a very small portion of the urethra, a line in extent, for example, the complete dilatation of the contracted part to the natural diameter of the canal may be effected at one time, and instruments of the largest size introduced without difficulty. In such instances a transition from a sound of one size to one considerably larger may be made without observing the order of proportion before laid down.

Where, on the other hand, the stricture is of some extent, and there is great density of the parts, which may be judged of by the degree of resistance made to the introduction of the instrument, and the firmness with which it is grasped by the stricture in attempting to withdraw it, it may be necessary to repeat this process at the interval of three or four days, for three, four, or more successive times, proportioning the enlargement at each time to the sensibility or rigidity of the parts.

At each renewal of the dilatation it will be found that the stricture has relapsed towards its former size, so that although an instrument of considerable size may have been introduced at a preceding operation, it will either enter with great difficulty or not at all; and this circumstance ought to be guarded against the more cautiously, as all unsuccessful attempts of this kind render the introduction of instru-

ments at the time, of any size whatever, the more difficult. It is prudent therefore to commence the operation by introducing an instrument of smaller dimensions than the largest which had been introduced at the preceding one.

It is an invariable consequence, that instruments which are introduced with much difficulty at a former occasion meet with little or no resistance at the subsequent one. The symptoms of the complaint are alleviated in proportion as the passage for the urine becomes enlarged. Where an instrument of the smallest dimensions has passed through the stricture, or even merely penetrated the smallest part of it, the frequent incitement to empty the bladder, or the inability to retain the urine in cases of incontinence, are materially diminished.

The tendency of the stricture to relapse gradually into its former state renders it necessary, after the complete dilatation of the part, to pass a full-sized instrument, at an interval of five or six days, for two or three weeks.

Occasional Effects of the Introduction of Instruments.

It not unfrequently happens that the instrument is so firmly grasped in the urethra as to require a considerable effort to remove it, occasioning more pain to the patient than the introduction of it ; this arises, I think, not merely from the action of the muscular parts upon it, but from the surface of the instrument

itself becoming dry by being long retained in the passage. Under such circumstances it is better to allow an interval of a few days to elapse before attempting the further dilatation of the stricture, when it will be found at each successive operation to bear with freedom the introduction of instruments which before it would not admit without great difficulty ; on this account it is not desirable (nor am I sure that the cure is expedited by the practice), of allowing instruments to remain in the passage of the urethra for more than a few minutes. The consequence of this dilatation, or in some cases the laceration of the stricture, being to produce a slight degree of inflammation and tenderness of that part of the urethra, it becomes necessary to abstain from a repetition of the operation for three or four days, until the parts have had time to regain their former quiet state.

The immediate consequence of the introduction of large instruments through the stricture is generally a slight hæmorrhage from the urethra, which occurs as often as the patient empties the bladder during the first or following days.

It is reasonable to conclude that the mode in which the enlargement of the canal is effected is by a laceration of the contracted part, especially when it is of a dense or cartilaginous texture ; and as the membrane of the urethra in its natural state admits of great expansion without any injury or blood being effused from its surface, it is also reasonable to infer

that it is to the unyielding or contracted part of the urethra only to which the injury is limited. In those cases however in which the dilatation is effected more slowly, bleeding from the parts is not so likely to occur, the condensed structure of the membrane of the urethra constituting the stricture being in such instances gradually wasted or absorbed. To produce such an effect by the use of bougies, for the reasons already stated, would be attended, as Mr. Hunter admits, with such pain and other unpleasant symptoms as few would choose to bear. It ought I think to be held as an invariable maxim, that when any hæmorrhage, however slight, takes place on withdrawing the instrument from the urethra, whether it have been passed into the bladder or not, to desist from any further attempts at that time. The presence of blood in the urethra, by adhering to the instrument, render its introduction difficult and uncertain; where it has not entered the bladder some injury may have been done to the healthy portion of the urethra, and as it is difficult to prevent any instrument from following the route of a former, the evil would necessarily be increased by persevering in the attempt.

I have stated that in general an interval of three or four days is requisite to enable the parts to recover their quiescent state, during which the introduction of instruments is rendered more difficult and painful, from the irritation excited by the former operation; on this account, where the stricture is so small that

its aperture cannot be easily detected, and the parts have been irritated by unsuccessful attempts to discover it, a longer interval of time is necessary. In such cases it will be found advantageous to postpone a repetition of the attempt for seven or eight days.

Another effect common to the introduction of all instruments, especially of a large size, from irritation of that part of the urethra near to the bladder, is the occurrence of rigors and other marks of febrile excitement, especially if the patient has afterwards exposed himself to a cold air; and sometimes, though very rarely, a swelling of the testis. These effects are however so unusual, that they are rather to be looked upon as marks of peculiar susceptibility of the individual, just as in some persons the mere introduction of an instrument within the orifice of the urethra will for the first time occasion fainting.

SECTION IV.

General Remarks on Strictures and other Affections of the Urethra attendant on them.

The parts of the urethra most liable to stricture, although no part of the canal is wholly exempt, are found to be at the distance, or nearly so, of $5\frac{1}{2}$ and $3\frac{1}{2}$ inches from the external orifice, and at the orifice or meatus itself. An explanation of the causes which give rise to the more frequent occurrence of obstruc-

tion at the two former of these particular points, I have endeavoured to point out in the preceding remarks on the anatomy of the urethra.

The first of these, or that which is met with at the distance of about $5\frac{1}{2}$ from the meatus or the part nearly corresponding with the arch of the symphysis of the ossa pubis, is by far the most frequent seat of the disease. The second, or that met with at the anterior part of the canal, near the root of the penis, or attachment of the ligamentum suspensorium penis to the symphysis pubis, at nearly the length of $3\frac{1}{2}$ inches from its orifice, is of less frequent occurrence. Although it is attended with the same general symptoms as the former, it has this peculiarity generally belonging to it, that its texture is in some instances almost cartilaginous. It has also a greater tendency to relapse into its former state as soon as the means of keeping it open are laid aside, and the density of its structure presents such a resistance to any means used for enlarging it as to render its tendency to contract extremely tedious and difficult. I think that stricture in this part is also more frequently attended with incontinence of urine than that which takes place near the bulb or membranous portion of the urethra.

Being from its situation more accessible to instruments than those at a remote distance, straight bougies, and especially those of cat-gut, which expand by moisture, may be often used with the greatest ad-

vantage; but the removal of the stricture by these means becomes exceedingly tedious, and the tenderness of the parts, occasioned by the frequently repeated introduction of instruments, prevents their being used with freedom. It is in cases of this kind that the steel wire sound with an obtuse edge on the curved part is peculiarly advantageous in the abridgement of time and the comparative ease with which the dilatation of the part can be accomplished.

Another part at which stricture of the urethra sometimes occurs is its external orifice. A diminution of the external meatus of the urethra is sometimes congenital, but more frequently the consequence of a destruction of a portion of the glans penis from venereal sores, the edge of the orifice being lost in an indurated cicatrix. In the latter case the opening is sometimes scarcely large enough to admit the point of a knitting-needle. This part of the urethra being peculiarly sensible, the distension of it by bougies is attended with much pain, and as the part quickly returns to its former contracted state after the means employed for this purpose are discontinued, and as the contracted portion is seldom more than a line or two in extent, the most effectual, and perhaps upon the whole the easiest method, is to divide the lower part of it by the knife or bistoury to an extent proportionate to the natural size of the passage. By this means the natural form of the meatus is preserved. If any hæmorrhage should ensue, which may some-

times occur without precaution, and prove troublesome, or at least alarming to the patient, it may easily be restrained by pressure.

Fistulous Openings.

In cases of fistulous openings into the urethra *anterior* to the scrotum, where there has been considerable destruction of the corpus spongiosum from ulceration, brought on by the use of caustic applications, or the consequence of venereal phagedenic sores, &c., the introduction of instruments for the purpose of enlarging the contracted portion of the urethra is not only attended with great pain, but fails in affording the relief which it does where they take place in other parts of the canal. Those, on the other hand, met with in the perinæum or scrotum, following urinary abscesses (dépôts urineuses) communicating with the urethra, from which the urine is chiefly discharged, readily admit of a cure by this mode of treatment. In the generality of these cases the contraction of the canal commences at some distance anterior to the fistulous opening, and a small passage is left for the natural course of the urine; but it has happened that the part anterior to it has been wholly obliterated, and the urine entirely discharged through the fistulous foramina.

In these instances, the steel sound, from its high polish, smoothness and permanent form, possesses great advantages over every other kind of instrument

in occasioning less pain and being more under the command of the operator.

Enuresis.

The immediate effect of obstructions in the urethra is to counteract the powers of the bladder, and consequently to prolong the time of its emptying itself, and to cause a diminution of the stream of urine, the last portion of which dribbles away or is voided in drops. To these succeed an increased irritability of the bladder, occasioning frequent efforts to expel the urine, so that the patient is compelled to rise four or five times or oftener during the night, especially after drinking more than usual, and proportionately repeated calls in the daytime. When these symptoms have continued for a length of time, especially in persons beyond the middle period of life, the urine sometimes comes away insensibly, more especially before and after the natural efforts to expel it, or when the natural incitement to do so is not immediately obeyed. This involuntary discharge of urine takes place sometimes in such a degree that the patient's linen and bed are constantly soaked with it.

Another indirect or remote consequence of long-continued obstruction to the passage of the urine, although common to other affections of the urinary organs, is an inflamed state of the mucous membrane of the bladder, and a discharge of glairy, tenacious, or sometimes puriform mucus mixed with the last por-

tion of urine expelled from the bladder, rendering it turbid, and adhering firmly to the vessel in which it is deposited.

The enuresis which takes place from stricture of the urethra differs from that arising from paralysis or irritability of the bladder. In the former of these (paralysis of its muscular coat), from injury to the spinal marrow, the bladder becomes completely distended and incapable of expelling its contents, and the urine by its mechanical pressure upon the neck of the viscus insensibly flows away in proportion as it is secreted. In that of irritable bladder, the urine is suddenly expelled in a gush, and often takes place during the night, the patient being sometimes suddenly awoke by it. In cases of stricture of the urethra, on the contrary, the patient having, in a greater or less degree, the power of expelling the urine by the natural efforts, the *stillicidium urinæ* takes place only at intervals, the urine escaping slowly and *guttatim* without his consciousness before, but more frequently after the natural efforts to expel it. This symptom, I think, is much more frequent where the obstruction is seated in the anterior part of the urethra, *i. e.* at the distance of 3 or $3\frac{1}{2}$ inches from the orifice, than at the membranous or posterior part of the canal. This troublesome symptom is so common among the lower orders of society, that I am not overrating the account in saying that nearly one-fourth of the number of cases which I have witnessed

among persons of this class have been of this description, while, on the other hand, cases of stricture accompanied with gleet have been comparatively rare. It is impossible to read Mr. Hunter's account without being struck with the fidelity and ingenuousness of his remarks on this subject, and it is therefore the more surprising to find him passing over in silence a symptom which so frequently occurs under the circumstances I have mentioned, and representing what is comparatively rare, the gleet as a general and almost constant attendant on stricture of the urethra.

The removal of the stricture in cases of enuresis, or of the other consequences now enumerated arising from this cause, is necessarily a cure of those complaints, which progressively diminish in proportion to the dilatation of the contracted part of the canal, and the ease and readiness with which the urine is discharged from the bladder. Those accompanied with gleet are more difficult on the whole to remove, and more subject to relapse than the others.

Retention of Urine.

The causes of retention of urine, or an inability of the bladder to expel its contents, may exist in various degrees, and may be total or incomplete, according to the nature of the cause which gives rise to it. They may be arranged under the following heads :—

1st. Paralysis of the muscular coats of the blad-

der, arising from injuries to the spinal marrow or from apoplexy *.

2nd. Enlargement of the prostate gland.

3rd. Inflammation of the neck of the bladder, or rather of the prostatic and membranous portions of the urethra.

4th. Obstructions in the urethra.

In the first of these forms the bladder loses its excitability and the power of expelling its contents, while the sphincter muscles retain their natural contractility. The bladder here becomes enormously distended, and the urine by its mechanical pressure on the neck of that viscus, after a certain period of time, is voided insensibly in proportion as it is secreted by the kidneys. There being no mechanical resistance to the passage of the urine, it may be sometimes forced out by mere pressure upon the bladder.

In enlargement of the prostate gland, the stoppage of the urine is usually incomplete, a small quantity only being retained, and the greater part of it voided by the natural efforts. This partial inability of the bladder to empty itself is one of the distinguishing characters of the enlargement of the central part† of the

* Chopart.

† The anatomy and effects of the enlargement of this part of the prostate gland, to which the term third lobe has been applied, is not a discovery of modern times. It was accurately described by Santorini in 1739, and subsequently by Camper, and is alluded to by Morgagni in the Third Book of his Epistles.

gland, the quantity retained, which seldom exceeds 4 oz., depending on the degree of enlargement of the part. The same effect does not follow an enlargement of the lateral parts of the prostate gland. Instances of this description do however occur, in which the retention is complete, no urine whatever being discharged by the natural efforts, and where consequently the use of a catheter is required three or four times or oftener in the twenty-four hours.

The third and frequent source of retention of urine is that arising from inflammation at or near the cervix, as it is called, of the bladder. The causes which give rise to this are various, but there is one which sometimes occurs, of which little or no notice has been taken, *i. e.* the more virulent species of *gonorrhœa*, in which the inflammation extends to the membranous part of the urethra and neck of the bladder, and sometimes to the bladder itself, from which mucus or pus is discharged mixed with the urine, as in inflammation of this part arising from other causes. This circumstance happens in the first stage of the disease, and generally about the fifth week from its invasion, either in consequence of violent bodily exertion, or excesses in living. The retention in these instances is at first seldom complete, but commences by strangury, or the frequent excitement to contraction of the muscular parts concerned in the expulsion of the urine, occasioning painful and incessant efforts to expel the urine, which is voided only

by drops, until at length the inflammatory action has run so high as to interrupt the discharge of it altogether.

In relieving the distention of the bladder in these cases, it is hardly necessary to observe that the first object ought to be the removal of the inflammatory symptoms; and that the introduction of instruments, were it always practicable, on account of the insupportable pain attending it, is sometimes unnecessary, and ought only to be resorted to where the general measures used for its relief have been found ineffectual: otherwise so long as any retention, though partial, continues, it will be necessary to relieve it by the use of the catheter.

One of the worst kinds of retention of urine, and most difficult of relief, is that attending stricture of the urethra. The anxiety of a person labouring under this complaint, from whatever cause it may arise, and the painful fits of straining to empty the bladder, may be fitly compared to the paroxyms of difficult parturition, where the powers of nature are unequal to the expulsion of the child. Notwithstanding the enormous distention which the bladder sometimes undergoes, a rupture of this part never does take place, I believe, from the *mere* distention of its coats. Long-continued and repeated attacks of ischuria give rise to inflammation and great thickening of the membranous and muscular coats of the bladder, and sometimes, though rarely, to an ulceration of some portion of it,

and as a necessary consequence, to an effusion of its contents into the cavity of the abdomen.

Although the mechanical obstruction may be the principal obstacle to the passage of the urine, it is never alone, I believe, so complete as to produce an entire retention; for however small the opening in the contracted part of the canal may be, the urine will continue to be voided, though with pain and difficulty, so long as the parts remain free from inflammation. It is on this account that an entire retention generally takes place after excesses of one kind or another, but more especially that of drinking.

Whatever means are resorted to for the purpose of removing the mechanical cause of obstruction, they do not therefore preclude the necessity of employing the general measures of lessening inflammation and spasmodic action, viz. general or topical bleeding, the warm-bath, opiate injections and antiphlogistic purgatives, among which I consider calomel in large doses as the principal.

In old and confirmed strictures the part is generally so much contracted as to render the introduction of a catheter even of the smallest size rarely practicable. The only means which seem to promise success are that of passing a fine bougie down to the contracted part, and endeavouring to force the point of it within the aperture. If this can be effected, and the instrument suffered to remain for some time, on its removal the urine will sometimes be discharged in a very

small stream, or by drops; but at each successive effort a small quantity will be voided sufficient to relieve the most distressing symptoms, and by a perseverance in the same measures, the stricture may be gradually enlarged, and the necessity of puncturing the bladder thereby avoided.

An ingenious method has been suggested by Mr. Trye* of relieving the distention of the bladder under these circumstances, by means of an exhausting syringe adapted to the extremity of the catheter, which he designed to employ on the principle of an hydraulic machine, and thereby evacuate the urine. His instrument, as might be reasonably expected, failed him in the only instance in which he had an opportunity of making trial of it, from the atmospheric pressure acting on the sides of the urethra instead of the fluid in the bladder. From some experiments made on the dead subject, he is of opinion that this consequence may be still obviated by distending the urethra with oil. The desideratum here sought for I am disposed to think, at least in very many instances, would be found in the use of the fine steel sound, directed carefully along the course of the canal of the urethra in the manner before described.

Where the opening in the stricture deviates, as is often the case, from the line of the urethra, a fine bougie possesses an advantage over every other instrument, in adapting itself to the irregularity; but

* On the Retention of Urine.

in proportion to its fineness it becomes more liable to bend on the slightest resistance, and when the point has entered the contracted part the waxy coating is ruffled up so as to prevent its advancing further. The instrument proposed is not only free from the latter disadvantage, but by uniting the two qualities of firmness and tenuity, gives the operator a command over it which he cannot have upon soft or flexible instruments. On this account the two kinds of instruments will be often found subsidiary to each other, and more useful than when employed separately. In cases where the stricture has been so narrow as not even to admit these instruments, I have more than once succeeded with a fine curved whalebone bougie, so tapered that the point has scarcely exceeded the size of a bristle.

The notion of the absolute necessity of introducing a catheter into the bladder in these cases, leads often to ineffectual attempts to perform what is impracticable, and thereby to render the use of other means more difficult and uncertain. The simple introduction of an instrument, however small, through the obstructed part, when the retention arises from this cause, will, I believe, be found sufficient to procure a flow of the urine, and to relieve the distention of the bladder, and thereby allow of time for the dilatation of the stricture. And it is worthy of observation, that however small the quantity may be which is voided, it will, *pro tanto*, take off the distention of the bladder,

and consequently the straining and spasmodic pain, almost as effectually as if the bladder had been emptied by drawing off the whole of its contents by means of the catheter.

I have thought it useful, in concluding these remarks, to introduce the following short examples, not only as proofs of some of the facts now stated, but of the great advantage to be obtained in cases of retention of urine accompanied with stricture, by the simple introduction of very fine instruments, where the use of a catheter would be impracticable.

Case 1.—I was called late in the evening to see a medical student, 23 years of age, who was suffering paroxysms of extreme pain, which returned at intervals of ten or fifteen minutes, from a retention of urine, which had lasted fourteen or fifteen hours. He had contracted a gonorrhœa three years before, which had never entirely ceased; the stream of urine had been for some time very small, and he had had two or three attacks of this kind (ischuria), which had been relieved by the warm-bath and other general means. On these occasions attempts had been made, by different surgeons, to pass catheters into the bladder, but without success, which had been always, as I found, attempted in the recumbent posture. This position being the most inconvenient and unfavourable to the introduction of instruments into the bladder, the patient was placed in a standing position;

a steel sound $\frac{1}{24}$ inch in diameter was passed down very gently to the membranous part of the urethra, in the manner already described, and after turning the point of the instrument upwards, entered the bladder with little resistance except at the point over which (I apprehend) the levator ani muscle passes. After the instrument had been retained two or three minutes he felt an inclination to make water, and on withdrawing it, he was overjoyed to find that the urine came away in a very fine stream, and without the straining and spasms which he had before experienced. The quantity of urine discharged at the first effort was very small, yet he was entirely relieved from the acute pain which he had before suffered. He was directed to take ten grains of calomel with some extract of hyoscyamus, and was put into a warm-bath. The bladder continued to empty itself at short intervals during the night, and on the following morning he found the stream of water larger than it had been for some time. Three days afterward I passed three instruments in succession into the bladder, of a moderate size, after which he found himself so well that he was unwilling to submit to any further enlargement of the diminished part of the urethra.

Case 2.—J. Devonshire, aged 42, had laboured under a retention of urine, and had had no sleep during forty-eight hours, a few drops of water only having escaped during repeated violent strainings to empty

the bladder, which could be felt extending as high as the scrobiculus cordis. I learnt from him that he had had a similar attack some years before, that the stream of urine had always been small, but had become very sensibly diminished after contracting a gonorrhœa. He had had besides an incontinence of urine during the last five years, and a discharge of mucus mixed with the urine for three or four months. The orifice of the urethra was so small, in consequence of a portion of the glans having been destroyed some years before by a venereal ulcer, that it would scarcely admit the point of a fine probe. The use of a catheter, even of the smallest size, was therefore impracticable. After being put into a warm-bath, in which he fainted, I introduced a very fine steel sound of $\frac{1}{24}$ diameter, the orifice being too contracted to admit of a larger instrument. After turning the instrument, and pressing it gently downwards, the handle being nearly in a vertical position, it passed through a point at the distance of 6 inches from the orifice by a sudden jerk, as if a small band had been thrown across that part of the urethra, which was ruptured by it, and went on into the bladder with the utmost ease. On its removal a small quantity of matter gushed out and afterwards some urine. In the course of two hours two quarts of urine were voided, and the same quantity during the night and following morning. Four days from the attack the urine became of a light colour, the quantity still very great. The tumour formed by

the projecting bladder now extended half-way between the umbilicus and pubes, and was less tender to the touch. After enlarging the aperture in the glans by dividing the lower edge with a bistoury, I was enabled to introduce instruments of the proper size. At the end of three weeks the enuresis had ceased, the bladder emptying itself only twice in the twenty-four hours, and at the end of two or three weeks more the urine flowed with more freedom than he had ever before recollected, and all his complaints appeared to have left him.

Case 3.—Stroud, æt. 50, Cottages, Junction Road, July 1st. In this instance the retention of urine had continued twenty-four hours, after drinking a good deal of beer. He had had a stricture of the urethra for some time, and now and then a stoppage of urine, but only for a short time.

Venesection, warm-baths, and various attempts to pass instruments had been unsuccessful. He was in great torment. Being a strong lusty man, and the weather hot, his shirt was bathed with perspiration, and hung like a wet sheet upon him. A very fine sound passed nearly into the bladder, but as there had been bleeding from the urethra in consequence of the introduction of instruments, I withdrew it, fearing the use of any force, and introduced a very fine bougie, which went into the bladder, and being retained a few moments was withdrawn, and the *urine*

followed immediately on its removal in a small irregular stream, not exceeding in quantity 3 or 4 ounces, after which he became perfectly easy. In a few moments the inclination to empty the bladder returned, and he voided more, and only complained of the burning sensation in the urethra, partly occasioned by the use of instruments. All the urgent symptoms having been now relieved, the treatment of the stricture was left in the hands of his medical attendant, who had no difficulty in removing it by the ordinary methods.

THE END.

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